CORNELL DEVELOPMENT GROUP

Strategies for Sustainable Development

Final Report

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1.0 INTRODUCTION

It is now eight years since the World Commission on Environment and Development issued its call for sustainable development principles to inform all aspects of planning and practice. The publication, Our Common Future galvanized a response around the world leading up to the U.N. Conference on Sustainability and the Environment in Rio. In this country, countless conferences, government roundtables, and both public and private initiatives have sought to bring substance to the urgent appeal. Yet, in measured terms, there is little to celebrate. Fisheries are in a rapid state of decline, pressures to cut the last of the Nation's old growth forests is unrelenting, groundwater is contaminated everywhere, fossil fuel consumption is increasing while the carbon time bomb is ticking.

And all this in a land rich in resources, low in population density and reacting generously to the world community. Although most citizens feel a deep concern about the prospects of a healthy planet for our children, the behavioral changes required are stifled by both personal and institutional inertia. It is, however, our inevitability that current patterns cannot persist and it is the role of urban planning to anticipate emerging conditions and seek accommodation in a way that benefits society as a whole.

1.1 Purpose

This report endeavours to relate the planning and development of the new community of Cornell to principles of environmental sustainability. It is not a regulatory document that prescribes a solution, but rather an overview of urban impact, what specific objectives need to be pursued, how conformance might be assessed, and an outline of potential responses.

Although first phase planning is near completion, opportunity has been kept open to significantly advance sustainability potential in the execution of the development. It is the purpose of this report to provide guidance in moving beyond conventional development practices both in the construction of Phase 1 and planning for subsequent phases so that Cornell might be exemplary of the New Urbanism's inclusion of ecological health in its planning principles.

Review of the Urban Design and Amenity Guidelines, Open Space Master Plan, and Streetscape Plan from the standpoint of sustainability has already been undertaken. Although many key aspects lie beyond these instruments, efforts were made to ensure that opportunities were not compromised. Other elements are discussed under General Planning and Infrastructure.

Achieving sustainability requires radical departure from current practice in virtually all aspects of development and economic life. Such a challenge has begun to be met in projects around the world. There will be of necessity resistance, "teething pains", and steep learning curves. The imperative of our children's future will propel the process.

1.2 Goals and Objectives

Much of the debate around sustainable development has centred around how to move forward incrementally while maintaining stability in our economy and its institutions. This has lead to some confusion as to what sustainability means. It is instructive to begin by defining it in absolute terms to be realized at some future state (i.e. a visioning exercise) and then using criteria of performance, assess how current actions might either jeopardize or facilitate realizing the objectives.

In order to provide some specificity to the general goal of reaching sustainability in the Cornell of the future, the primary categories of environmental impact are given the following objectives.

1.2.1 Biophysical Ecosystems

The recognition of our interdependence with the living world in all its complex forms and relationships is central to an understanding of sustainability. Restoration of an ecological balance in the context of new urban development is a central objective.

1.2.1.1 Physiography and Topography

Landscape form is respected as natural heritage. Built form is designed in harmony.

1.2.1.2 Soil

Nutrients and vitality and structure of soils on the site are not diminished and are even improved in order to support a robust and diverse land ecology and biological productivity. Contaminated soils are remediated through treatment and future contamination is avoided.

1.2.1.3 Hydrology

Ground water quality is returned to a pristine state suitable for drinking and quantities are maintained through recharge by rain, irrigation and treated return.

Contamination either by excessive nutrients or toxins is eliminated. Surface water in the form of creeks, wetlands, and ponds is integrated with the urban landscape to form diverse habitat, swimmable conditions and stormwater management such that restore the biodiversity and natural hydrology of the watershed.

1.2.1.4 Forestry

Reforestation of the area in native species with significant tracts and, in particular, riparian conditions and greenways returned to natural growth provides species habitat, microclimate enhancement, precipitation moderation, woodland resources, and public amenity.

An associated forestry preserve capable of sustaining the demands of the community for wood products is secured so that a bioregional balance of demand and supply is maintained.

1.2.1.5 Agriculture

Optimal use of the local land base inside and proximate to Cornell for food, biomass, and agriproducts is achieved so that most of the community's needs are supported by local farming and export offsets import.

Production and processing is achieved through organic farming practices, low energy input, and local participation.

1.2.1.6 Greenways

Linkages of natural heritage areas form wildlife corridors, recreational trails, and ecological connectivity. Biophysical ecosystem functions are incorporated. Coexistence with the wild is nurtured.

1.2.2 Energy

Ultimately all human activities will need to rely strictly on renewable energy sources that are derived and used without deteriorating the natural environment. Currently, efficiency improvements and various renewable energy technologies are sufficiently affordable to warrant their adoption and to justify energy sustainability; however, consumer and producer predispositions retard development. Climate change, acid rain, nuclear waste proliferation, and urban smog are amongst many compelling reasons to advocate a speedy transition to a clean energy future.

1.2.2.1 Building Energy Use

Individual buildings or groupings will be capable of generating more renewable energy supply than they utilize thereby powering other demands.

1.2.2.2 Embodied Energy

The materials, construction and maintenance of the built environment will be accomplished with renewable energy. In the transition period, buildings that have used non-renewable resources will export sufficient renewable energy to cover the expenditure.

1.2.2.3 Transportation

The movement of goods, people, and information will be powered entirely from renewable sources. Ultimately this would include connections and commerce with the rest of the world.

1.2.2.4 Industry

All goods produced or consumed by the community are derived from processes driven by renewable energy.

1.2.3 Materials

Materials used in the community are derived from sustainable sources either through biological production or re-use or reconstitution. The impact of original mining is ameliorated. Health impact of their presence is positive.

1.2.3.1 Construction

Materials and methods of construction are durable, long-lived, and either biodegradable or recoverable. Their original sources are primarily local and are derived from recycling, sustainable harvesting, or benign extraction.

1.2.3.2 Organics

All food waste, horticultural cuttings , livestock manure and sewage is composted and returned to soils locally.

1.2.3.3 Products

Consumer goods are designed for reuse and recycling.

1.2.3.4 Toxins

Chemicals harmful to humans and persistent toxins in the environment are eliminated or rendered harmless.

1.2.4 Health

The environmental conditions, both indoors and out, in the community of Cornell should be conducive to good health and well-being of its inhabitants. In the fullest sense, conditions that are supportive of physical, mental, emotional, and spiritual well-being include social, economic, cultural, technical and aesthetic attributes which are fundamental to planning objectives.

1.2.4.1 Water Quality

Drinking water, in addition to being odour-free, clear and free of pathogens, contains a healthy complement of minerals and is virtually free of carcinogens, tritium and other radioactive isotopes, free radicals and residual organic solids. Water of differing quality, such as soft water for washing, nutrient rich water for irrigation and non-chlorinated, biologically active but pathogen-free swimming pools are available to the community.

1.2.4.2 Outdoor Air Quality

Ambient air quality is at least as free of pollutants as the air entering the Cornell environment with a net decontamination effected by virtue of vegetation and building filtration.

1.2.4.3 Indoor Air Quality

Air quality indoors is conducive to good health with public facilities free of allergens and all buildings uncontaminated by soil gas entry, volatile organic compounds and other building source pollutants. Comfort and humidity are maintained at desirable conditions.

1.2.4.4 Noise

Undesirable noise generation is absent or isolated from areas of residency and street life.

1.2.4.5 Electromagnetic Fields

Power transmission conversion and use in buildings is sufficiently isolated so as to reduce electromagnetic field exposure to negligible levels.

1.2.4.6 Healthy Food

Access to toxin-free and nutritious food is afforded by local production, processing and distribution of organic agriculture and aquaculture.

1.3 Organization of Report

In order to fit with the planning instruments being employed to regulate the design of the first phase of development of the Cornell site, the suggested list of strategies to meet or move towards the sustainability objectives are organized under the following headings: Urban Design and Amenity Guidelines, Open Space Master Plan, Streetscape Plan, and General Planning and Infrastructure.

Some of the strategies are immediately implementable, others are longer term and provisions to accommodate them might be considered.

2.0 SUSTAINABLE DEVELOPMENT STRATEGIES

2.1 Urban Design and Amenities Guidelines

2.1.1 Rooftops

Flat and shallow sloped rooftops should be planted and function as stormwater retention, garden plots and outdoor amenity spaces. Larger roof areas with rainwater retention may act as cooling load heat rejection, cisterns, and constructed wetlands. Stepped flat roofs can be used to maximize solar access for rooftop gardens, solar collectors and passive heat gain.

2.1.2 Landscaping

Lot gardens and plantings should be water conserving and chemical free. Features such as xeriscaping, naturalized planting, deciduous tree planting for solar shading of windows, edible landscapes, and vegetable plots should be encouraged.

2.1.3 Stormwater

Stormwater should be primarily retained, used, and dispersed into the ground at each lot employing permeable paving, cistern or pond collection, landscape watering, infiltration trenches and drywells, and used for wash water. Storm drains are the last resort.

2.1.4 Building

Thermal envelopes should be upgraded from the Ontario Building Code to yield design heat loads of less than half current standards. In particular, total window insulation values greater than RSI 0.7, walls RSI 5.5, roof RSI 7.0, below grade walls RSI 3.0, floors RSI 1.5, and air leakage .75 air changes at 50 Pa pressure should be required. Building height and setback should allow for full sun penetration into building interiors in winter and for some sunspaces in yards in summer.

2.1.5 Windows

Where practical, south windows exposed to winter sun should have an area greater than 7% of floor area and less than 12% of floor area unless adequate storage of solar gain is provided.

2.1.6 Heating / Cooling

Space heating should be provided by a district energy system using heat from a renewable energy source cogenerator or in-situ renewable energy supply including low emission, high efficiency wood combustion, small-scale cogeneration using biogas, active solar thermal or other means.

Space cooling should be primarily passive with possible district cooling and aquifer circulation as backup. Ozone-depleting refrigerants should be banned. Power to circulate heating and cooling should be kept below 1W/m^2 of floor area.

2.1.7 Ventilation

Continuous ventilating capacity with heat recovery from exhaust to supply of minimum .75 effectiveness and low power fans is provided in all buildings.

2.1.8 Domestic Water Heating

Domestic water heating should be supplied by the district heating system with solar thermal auxiliary.

2.1.9 Lighting, Appliances and Equipment

Electrical loads should be reduced through inducement to purchase best available technology through utility or builder purchasing, promotion and financing.

2.1.10 C-2000 Programme

Industrial, commercial and institutional buildings should exceed NRCan's C-2000 programme standard and, where possible, provide for net export of electrical supply where feasible.

2.1.11 Solar Panels

Roofs should be designed to accommodate solar photovoltaic panels or roofing tiles and a programme of deployment developed through the public utility.

2.1.12 Water Conservancy

Should be practiced throughout with maximum 6 L toilets, low-flow shower heads, and progressive rate structures on meter billing. Composting (waterless) toilets, use of rainwater, and recycling of treated water should be encouraged.

2.1.13 Building Materials

Building materials should be selected for their low embodied energy, longevity, recyclability, recycled material content, sustainable sourcing, low toxicity and local production.

2.1.14 Soil

Topsoil should be preserved during construction by minimizing removal and disruption and by transferal to ready sites so as to avoid destroying soil vitality as occurs in long term storage.

2.1.15 Recycling

Convenient means of storing and setting out separated recyclables should be provided.

2.1.16 Household Products

Use of household products that are toxic, including certain solvents, cleaning products, pesticides, and paints, should be banned or discouraged.

2.1.17 Indoor Air Quality

Indoor air quality should be preserved through the use of low volatile materials, moisture control, effective ventilation and high efficiency filtration.

2.1.18 Transportation / Parking

Protected bike parking and showering facilities should be provided for all major commercial and institutional buildings.

Reduction of parking space requirements should be offered where alternative accessibility and transportation strategies are provided as part of a development proposal.

2.2 Open Space Master Plan

Beyond designated environmentally significant areas, natural heritage protection should include renaturalized areas and diverse habitats as part of an overall Greenways development that links natural and cultural heritage features. The overall system provides ecological integrity for wildlife, recreational enhancement, and promotion of stewardship and appreciation of nature. Restricted access and limits on recreational activity will be necessary to preserve conditions

2.2.1 Forestry

Link the major green spaces with planting of treed wind breaks along lot boundaries, at right angles to the prevailing wind direction. For forest areas within Cornell, designated as part of the Cornell Forest Reserve, sustainable harvesting and maintenance practices that support a healthy forest ecology should be exercised. Sales of forest products should offset costs of forest management.

2.2.2 Agriculture

Significant and dispersed portions of open space should be allocated to agricultural production through community garden allotments and leased usage. A diversity of agricultural production opportunities should be accommodated and promoted throughout the site. Zoning should ensure private and multiple unit lots have access to sunlight for home gardening. Edible landscaping such as fruit trees, berry shrubs and herbs should be incorporated into public planting with a procedure for harvesting developed. Agriculture and aquaculture production should be integrated into sewage treatment.

2.2.3 Stormwater Management

Stormwater management should be a major part of open space planning with vegetated swales, retention ponds, treatment marshes and infiltration sites fitting into Greenways, parkland and natural heritage features. Locate conveyance, storage and infiltration areas on land farthest from the active use areas (e.g. walkways and sports fields).

Swimming and fishing may be made possible with a well-engineered, ecologically designed waterway system.

2.2.4 Lighting

Public parks and walkways should be illuminated for safety and attraction using standalone solar powered lamps.

2.2.5 Noise

Noise generated by public events and outdoor sports facilities should be isolated from residences by location and sound barriers. Some public areas particularly in natural heritage sites should be designed for sound isolation from traffic and city noise.

2.2.6 Walkways

Locate pedestrian facilities to improve comfort and use; e.g. to receive some direct sunlight in winter and shade in summer. Consider wind speed and direction in the design of pedestrian facilities. Avoid lengthy straight sections prone to wind tunneling. Use curves and vegetation to retard winter winds while creating shaded summer conditions.

Trail materials should be sensitive to wildlife needs. For example, amphibians or reptiles cannot cross a rough (stone dust) trail.

2.2.7 Plantings

A wide range of vegetation should be used to define edges, aesthetics, and habitat for human and non-human use.

2.3 Streetscape Plan

2.3.1 Shade

Tree canopies, awnings and other shading elements should be extensive enough to shade summer sun on sidewalks and roadways for the protection of people on the street and creation of a cooler microclimate.

2.3.2 Wind

Hedges and wind barriers should be strategically located to moderate street level high wind conditions.

2.3.3 Rainwater

Methods to optimize infiltration of rainwater such as permeable paving of parking and light vehicular roads, vegetated swales along roadsides, infiltration trenches along curbs fed by catchment drains and tiles, constructed wetland in the median, etc., should be employed wherever possible to abate stormwater runoff rates and pollution and recharge groundwater.

2.3.4 Traffic

Traffic calming techniques, such as extended speed bumps and landscaped barriers for meandering passage should be incorporated in residential areas, particularly those traveled by children en route to school.

2.3.5 Bicycle Lanes

Bicycle lanes should be clearly marked and continuous through designated routes and regular bicycle locking posts provided.

2.3.6 Street Life

Pedestrian accommodation such as shelter, benches, separation from traffic, water fountains, and street commerce should be amply provided.

2.3.7 Transit Stops

Public transit shelters should be provided at all stops. They should be comfortable and attract use. Therefore they should contain the following elements: shelters, seating, shade and lighting. Transit stops should ideally be situated to intersect with pedestrian walkways and bicycle parking facilities.

2.3.8 Accessibility

Barrier-free access for all major disabilities including sound signals at stoplight intersections for the deaf, textured sidewalk markings for the blind, curb cuts for wheelchairs should be pursued throughout the community.

2.3.9 Street lighting

Street lighting should be designed for low power consumption through lowest acceptable light levels, high efficiency lamps, daylight controls and task specific luminaires. Fixture design to reduce light pollution for night sky viewing is desirable.

2.3.10 Lanes

Backlanes in commercial areas should be permitted for small commercial activities and pedestrian use.

2.4 General Planning and Infrastructure

2.4.1 Wildlife Management

Wildlife management should coordinate habitat enhancement, biodiversity, animal protection, monitoring of ecological conditions, use of natural areas and related functions that preserve and nurture wildlife species consistent with public safety and health.

2.4.2 Site Hydrology

Coordinated planning and maintenance of site hydrology including stormwater management, groundwater recharge and quality control, pollution prevention, water usage, treatment of sewage and stormwater runoff, and surface water should be implemented to ensure the healthiness of the watershed.

2.4.3 Forestry

A Community Forest Preserve should be established both on site and on suitable nearby lands to ensure a renewable supply of wood products for Cornell's needs using ecological forestry practices.

2.4.4 Community Food Council

A Community Food Council should be established to promote the production, processing, storage, and distribution of local food supply such that ample, healthy equitable and affordable nutrition from local and urban agriculture and aquaculture is achieved.

2.4.5 District Heating and Cooling

A district heating and cooling system should be installed for the whole community to capture the opportunity for higher efficiencies, cogeneration of electricity, cleaner air emissions, methane use from a community organic waste composter, elimination of ozone-depleting refrigerant use, lower service costs, and integration with other utility systems.

2.4.6 Public Transit

Public transit should be enhanced through a local circuit accessible to wheelchairs and the elderly, as well as general ridership using electric mini-buses.

2.4.7 Retail

Small grocers and household goods retailers should be situated in close walking distance to residences.

2.4.8 Grounds Keeping and Maintenance

Operations should give preference to non-petroleum based alternatives such as manual raking, low maintenance landscaping and infrastructure, electric vehicles and equipment,.

2.4.9 Sewage Works Energy

Energy efficient conveyance and treatment of sewage should be given priority in design selection and consideration should be given to electrical generation from hydraulic potential sewerage flow.

2.4.10 Water Treatment

Where disinfection of discharge waters is required, non-chlorine alternatives such as UV and ozone should be employed. Naturalized and ecologically treated swimming facilities rather than chlorinated public swimming pools should be provided.

2.4.11 Lawn and Garden Toxins and Pollutants

A ban on lawn sprays and garden sprays that are a danger to public health and contaminate aquifers should be instituted. Use of municipally generated soil additives from sludge and composting should be provided to the community. Some weed population should be accepted.

2.4.12 Accessibility Provisions

Accommodation of infirmities and disabilities should be provided as widely as possible. A significant amount of housing stock should be barrier-free for the elderly and ambulatory-impaired. Other accommodations for hearing, sight, chemical sensitivities and other disabilities should be investigated to ensure Cornell can house and permit maximum participation of all members of society.

2.4.13 Ecological Resource Centre

Cornell's prospects for sustainability would be greatly enhanced by the creation of a central community facility that provided utility services, waste management, and ancillary services to support sustainable living and development. Rendered as a public complex that exposes the community to their infrastructure and provides convenient means of continued participation in transforming environmental awareness into action, such a project could be seminal in establishing a model for ecologically-based development.

The advantages of such a facility are:

1. higher efficiencies of energy production;
2. lower emissions, better air quality;
3. lower capital and operating costs hence lower site services and living costs;
4. elimination of fluorocarbon air conditioning and outdoor units;
5. virtual elimination of waste;
6. local employment;
7. horticulture and aquaculture production;
8. water regeneration;
9. public awareness and inducement for improvement;
10. integration of functions for maximum yield at least cost.

The Centre would house a number of combined utilities and community facilities:

- communal compost and recycling depot
- living machine sewage treatment and water supply
- food and plant production
- biogas generation/delivery using methane digesters
- renewable based cogeneration/trigeneration
- additional electric generation from wind/PV generation
- integrated district energy and telecommunications distribution
- energy storage and heat rejection

It would also house a range of community services:

- municipal offices
- information centre
- Green Community headquarters
- special products outlet
- reuse centre
- financial, technical audit and other consulting services
- workshop and teleconferencing facilities
- theater, gallery and farmers market

2.4.14 Construction Waste Agency

- A Construction Waste Agency should be created in order to put in place the necessary infrastructure to result in zero export of construction waste from Cornell.

- Some activities and operations of the agency are noted below:

- the agency to provide a training program in waste minimization and management for builders;

- the agency to establish a major re-use centre on site;

- suppliers required to take back containers; e.g. of drywall mud and leftovers (paint);

- suppliers to commit to minimal, reusable and/or recyclable packaging;

- the agency to operate a recycling depot on site;

- builders to be responsible for source separation of construction waste (wood, metal, plastics);
- the agency to provide a separate depot for all hazardous materials;
- the agency to operate a central composting site for brush, including a chipping operation to provide wood chips for greenspace walkways;
- the agency to arrange for stockpiling of residual materials and periodic grinding of materials to be used as fill material on site;

2.4.15 Waste Diversion Progamme

Markham's waste diversion programme should be extended and expanded in Cornell to target for an 80% diversion rate. Methods to move towards zero waste disposal should be pursued such as reducing products consumed that are not economically divertable.

"Green box" pickup of compostables should be provided with delivery to the community methane digester.

2.4.16 Administration

A Healthy City Office should be established to coordinate and provide a central database measurement and monitoring of environmental and sustainability measurements and monitoring carried out by itself and other agencies.

An annual report should be generated that provides a report card on performance and advises on priorities, changes to planning and practices, and new initiatives. Both short term objectives and ultimate goals should be sufficiently elaborated that means of measuring success can be defined.

Parameters to monitor include outdoor air quality, ground and surface water quantity and quality, biological health, diversity and populations, energy consumption and production, transportation usage within and in and out of the community, CO_2 generation, solid waste generation and diversion, public health and satisfaction, local food production and consumption, and related economic impacts.

3.0 CONCLUSIONS

The prospects for Cornell becoming an exemplary planned community for sustainability are favourable. The unique process of plan development undertaken by the Province in concert with the City of Markham has resulted in many leading edge features informed by the New Urbanism. The current plan, controls and guidelines have set the direction for a more livable, environmentally responsible community. The strategies outlined in this report build on this foundation, adding opportunities to realize a more sustainable, healthy and appealing development.

Most of the strategies and measures require further expansion, evaluation, and administrative review before adoption and implementation. Some may be achievable in the first phase of development; others can guide the design and engineering of future phases and be introduced later into earlier phases. It is recommended that a feasibility assessment be carried out on major items and, if favourable, brought into the planning and design process as early as possible. Some items are possibly adoptable at face value in which case their inclusion in the first phase of development should be secured through appropriate instruments.

Focus should be given to the following major elements that would have most impact on sustainability:

- energy and water efficiency standards for buildings;
- stormwater management employing ecological approaches that recharge aquifers, remove pollutants, and provide natural amenities to the landscape.
- living machine sewage treatment with effluent reuse and an aquaculture/horticulture component.
- community energy system employing district heating and cooling, trigeneration fuel by biogas from municipal waste and other renewable energy supply options;
- measures to reduce automobile use and dependency, and trucking, priorization of accessibility, walking, bicycling, and public transit and non-fossil-fuel vehicles.
- comprehensive solid waste reduction and diversion programme for construction and municipal waste;
- forestry and agriculture initiatives explicitly linking Cornell's demands with local supply;
- institutional structures to deliver the various community sustainability strategies.

Achieving success with the objectives for sustainable development will require vision, commitment, and risk-taking by the many people who are involved with the creation of Cornell. Ultimately, the people who choose to make Cornell their home will make or break the proposition that this development could become a world model of ecological and sustainable human settlement.